

Forensic Evaluation of Video Footage from the TIGHAR 2010 and 2012 Nikumaroro Expedition

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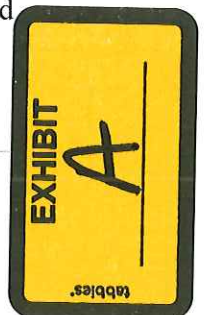
Introduction:

Positively identifying wreckage of historical significance, located in a remote area of the planet and under hundreds of feet of ocean waters is challenging and requires a scientific approach to methodology. Photointerpretation, as explained by the forensic image analysis expert working with TIGHAR, Jeff Glickman, includes taking the following list of items into consideration¹.

1. Differences in organic (natural) vs. man-made shapes.
2. Texture differences between objects within a neighborhood.
3. Pattern differences between objects within a neighborhood.
4. Color differences within multiple color spaces within a neighborhood.
5. Color absorption differences (spectrometry) between specific objects.
6. Temporal similarities vs. differences between video frames.
7. Object size and scale information which may be relative, absolute and ratiometric (mensuration).
8. Object interaction with its environment.
9. Location information including absolute position, relative position and context.

Methods:

Our team's methodology began with a frame by frame review of the underwater videos of the proposed crash site provided by TIGHAR, dated 2010 and also reviewed 2012 footage. These were viewed to visually identify potential objects associated with the Lockheed "Electra" Model 10E, Construction Number (c/n) 1055 aircraft, cabin contents and the crew members Amelia Earhart and navigator Fred Noonan. The potential candidates included those suggested by our team members and others identified by other individuals in public forums. A full range of items from specific plane parts to highly speculative and imaginative proposals were given consideration. From this group of potential candidates, those most suited for evaluation by mensuration, were selected for geometric comparison with specific objects or parts associated with the aircraft and its last flight. Multiple still frames of video were captured for the proposed objects and the proposed object outlined by a Professional Mechanical Engineer using computer drawing software (Microsoft Office Professional 2010). We relied upon historical photographs of the plane and of objects similar to those which were in the original plane for establishing the relative size and geometry of objects. Since the original blue prints of the plane were not available, we made use of the limited edition scale drawings completed by aircraft modeller William F. Harney in 2002 and published by TIGHAR in 2009. To corroborate the drawings and historical photographs, we inspected and photodocumented two of the approximately twelve Lockheed Electra Model 10s currently in existence. One of the documented aircraft was as a



Model 10A, c/n. 1052, located at the New England Air Museum in Windsor Locks, CT, the second was the only remaining Model 10E, Electra, c/n 1042, owned by, Grace McGuire of San Diego, CA. The McGuire Electra also had disassembled parts of the front and rear landing gear available for inspection and photography. The geometry of specific engineered plane parts was outlined with software to convert them into line drawings. These geometric shapes and outlines of actual parts were rotated and superimposed on the line drawings made of the proposed objects from the high resolution video still images. A modified superimposition method was performed by optimally translating, rotating and uniformly scaling the line drawings taken from actual plane parts to obtain the best fit with the line drawings made from the proposed objects in the video. That is, the two sets of drawing were used to determine if multiple geometric elements were a good fit. Multiple sets of drawings taken from the separate video still images were compared to the line drawings of the actual objects. The relative size and shape of multiple geometric elements were used to positively identify geometric congruence between proposed object and actual plane parts.

It was important to consider the possibility that objects observed on the slopes of the atoll were natural formations, derived from the coral reefs growing in shallower water. The accretion of reefs by corals and other organisms produces limestone objects that can be mistaken for man-made objects, particularly when broken and eroded over time. A specialist in coral reef ecology also reviewed the video and still images to identify objects least likely to be natural and to confirm that the objects positively identified by mensuration as corresponding to parts of a Lockheed Electra Model 10, were not merely natural formations and creatures mistaken for man-made objects. The specialist was also relied upon to comment on the effects of encrustation of natural debris and man-made objects over time.

Examples of historical objects superimposed upon the video are presented in the Figures Section.

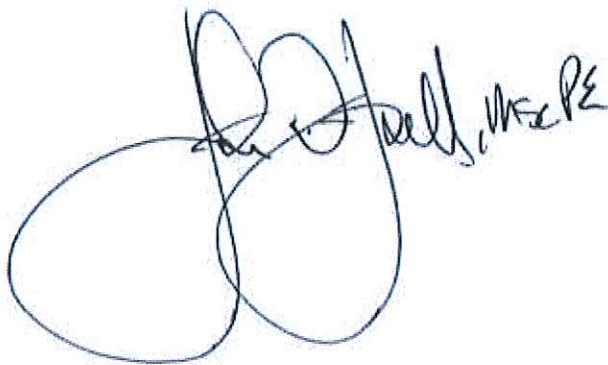
Conclusions:

From our review of the data, we have the following conclusions in regard to the 2010 TIGHAR video footage:

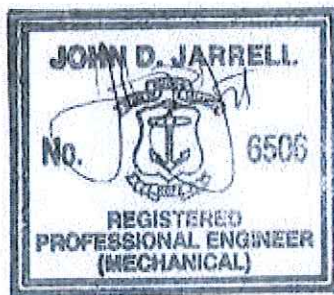
- 1) In addition to the rope/cable and wire clearly seen in the video from 2010, there are other objects observed which are man-made, by virtue of the fact that they are inconsistent with natural formations;
- 2) There is an object consistent in shape and geometry with a tailwheel as determined by geometric comparison with the tire and fork from a Lockheed Electra Model 10.
- 3) There is a collection of objects atypical of naturally occurring formations in some details of shape and coloration, but consistent with the front landing wheel, worm gear and strut assemblies; This object was determined to be more likely man-made than a naturally occurring formation. Our observation from the 2010 video are consistent with representation made in the TIGHAR bulletin concerning the 2012 video, where it states, "We have located a man-made debris field that is in the location that was expected and for which the shapes of the objects in the debris field are consistent with the object(s) seen in the Bevington image." ⁱⁱ;

- 4) There is the appearance of a black symmetrical object that is not of natural origin;
- 5) There is a black spiraled object which is almost certainly not of natural origin, consistent with historic, braided copper electrical wire; Such wire was present on the Earhart Lockheed Electra Model 10;
- 6) There is a separate debris field, approximately 400 meters from this location with objects from a known shipwreck (*S.S. Norwich City*);
- 7) The investigations of this region of the ocean floor and debris fields by the TIGHAR organization did not demonstrate migration of the *S.S. Norwich City*, shipwreck debris to the second location;
- 8) The objects in the 2010 video are not consistent with the objects from the shipwreck hull and superstructure debris field located approximately 400 meters away;
- 9) The objects we have identified in the 2010 video footage are consistent with parts of the Earhart Lockheed Electra Model 10 and, in the absence of an alternative explanation for the source of those objects, we conclude that they are likely to have originated from Earhart's Electra.

Sincerely,
Materials Science Associates, LLC

A large, stylized handwritten signature in blue ink, appearing to read "John D. Jarrell, PE".A handwritten signature in blue ink, appearing to read "G. Forrester".

Prof. Graham Forrester, PhD
Aquatic Ecologist



Figures Section



Figure 1. Image of crashed Electra, showing Vee antenna (top insert) and rope and tie down wires (bottom insert).



Figure 2. Image of Historic Lockheed Electra Model 10E worm gear (Grace McGuire). The object is represented by the intersection of two rays with a circle.



Figure 3. Top left image shows an assemblage of landing gear and worm gears from historical Lockheed Electra Model 10 (New England Air Museum in Windsor Locks, CT). Image of video still (middle) showing the appearance of landing gear and a worm gear. Bottom image shows portion of video image enlarged, cropped and rotated, with two rays creating an arc with an intersecting circle used to represent the proposed object.

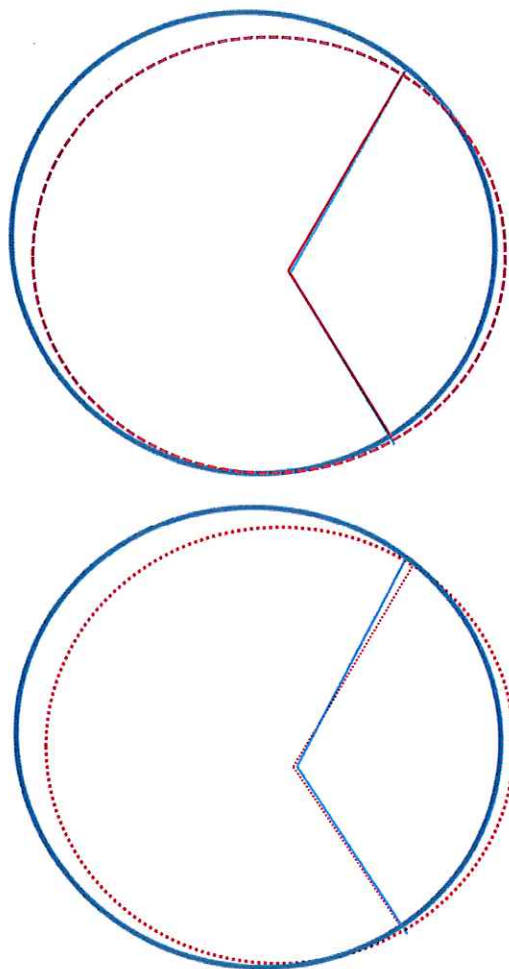


Figure 4. Two examples comparing the congruence of geometric traces of the actual historic worm gear (blue lines) transposed on traces made from two different video stills of the proposed worm gear in the wreckage (red lines).



Figure 5. Video still image showing a proposed front landing gear. Insert shows proposed landing gear cropped and rotated to the vertical position with the outline of historic landing gear super-imposed upon it. Fork and mud guard are rotated 50 degrees in the x-axis. The mud guard is shown to be rotated along the y-axis, so as to cover most of the tire. The tire is deflated to hub width and bent in the z-axis slightly. There is good relative position and aspect ratios between the three front wheel elements and the object identified in the video still image.



Figure 6. Black symmetrical object from cropped and enlarged still images from the 2010 video, consistent in appearance with a man-made object.



Figure 7. Video still showing a cable and the appearance of a circular object. The inserts show the outline of the Electra tailwheel from scale drawings compared to scale drawings (William F. Harney) compared to a region of the video still. Given that the outlined object is the rear tire of an Electra 10E, with a tire diameter of 16", then cable is over approximately 0.37" diameter at the thin region, not accounting for encrustation.

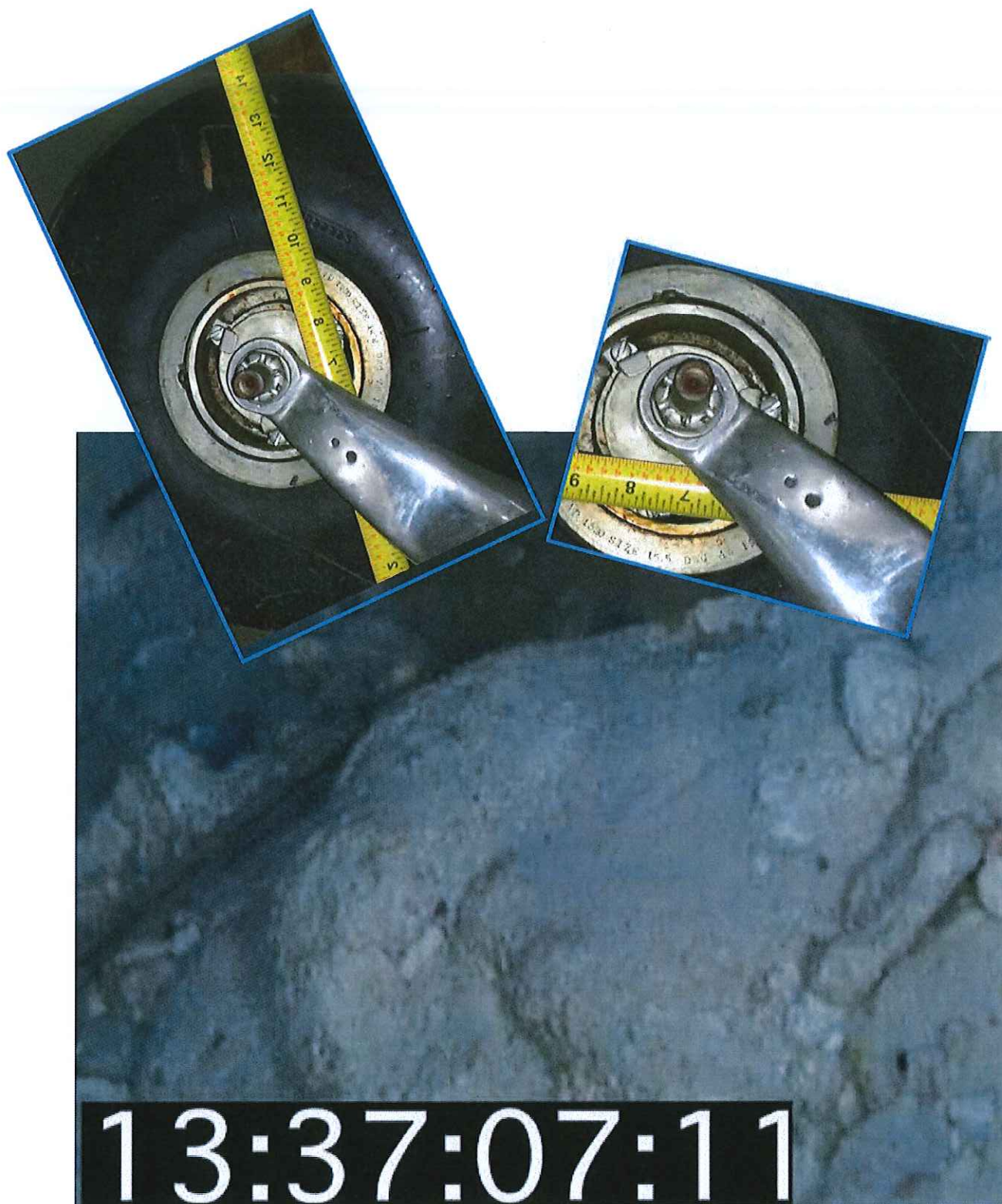


Figure 8. Images of historic tailwheel (top insets, New England Air Museum in Windsor Locks, CT) adjacent to cropped and enlarged image of the proposed tailwheel in the wreckage from the 2010 video still image.



Figure 9. Black wiry object in 2010 video (arrow) and example of historic shielded cable (top insert). Bottom insert is a Western Electric 631B microphone insert compared to close-up of black wire from 2010 video still image 13:38:32:08. Head piece and pig-tail cord of the microphone are to scale with the objects in the video still image as shown in blue-dashed outline. (Note, pig-tail added at a later date, but of similar wire diameter). Top insert is of a Western Electric REG US PAT OFF USA 588A.

<http://www.wehrmacht-awards.com/forums/showthread.php?t=211714&highlight=western+electric>

ⁱ http://tighar.org/Projects/Earhart/Archives/Research/Bulletins/63_DebrisField/63_DebrisField.htm, TIGHAR, Earhart Project Research Bulletin, August 26, 2012

ⁱⁱ http://tighar.org/Projects/Earhart/Archives/Research/Bulletins/65_DebrisFieldAnalysis/65_DebrisFieldAnalysis.html, TIGHAR, Earhart Project Research Bulletin #65 from October 2, 2012